

High power RF & LLRF systems for CeC PoP Experiment in RHIC

Alexander Zaltsman

March 11, 2013



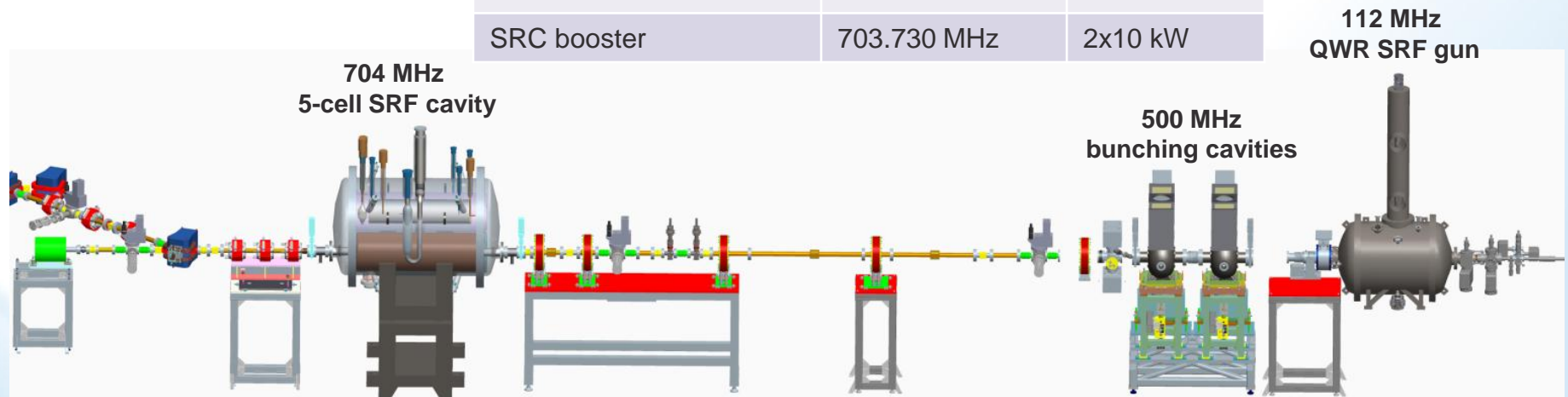
U.S. DEPARTMENT OF
ENERGY

Office of
Science

Overview

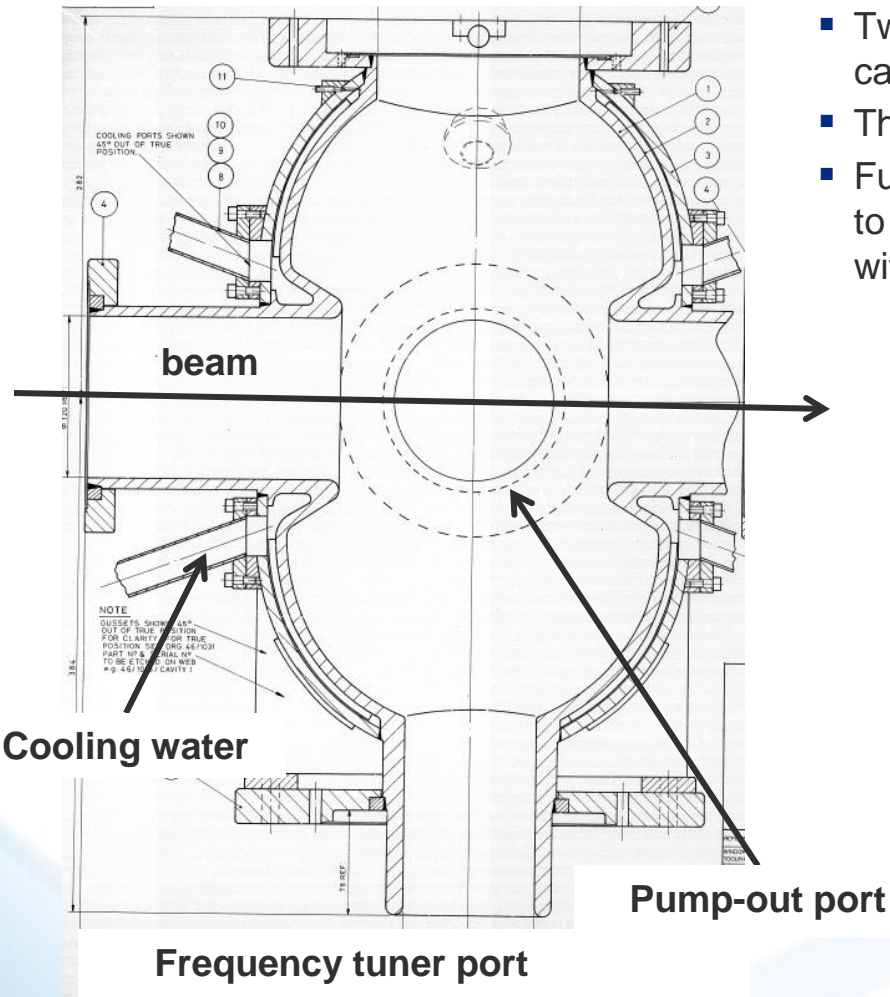
- There are three SRF/RF systems in CeC PoP linac set up:
 - A Quarter-Wave Resonator (QWR) type SRF gun, operating at 112 MHz. This gun will generate 2-MeV, high charge (several nC), low repetition rate (78 kHz) electron beam.
 - Two normal conducting 500 MHz single-cell buncher cavities, on loan from Daresbury Lab. The cavities were formerly used in SRS.
 - A 704 MHz 5-cell SRF cavity (BNL3) to boost the energy of electrons to 22 MeV.
- RF power amplifiers and LLRF electronics are located in a building outside the RHIC tunnel.
- SRF cavities will be covered in John Skaritka's presentation.

Cavity	Frequency	HPA power
SRF gun	113.041 MHz	2 kW
2 NC bunching cavities	500.006 MHz	35 kW
SRC booster	703.730 MHz	2x10 kW



Normal conducting bunching cavities

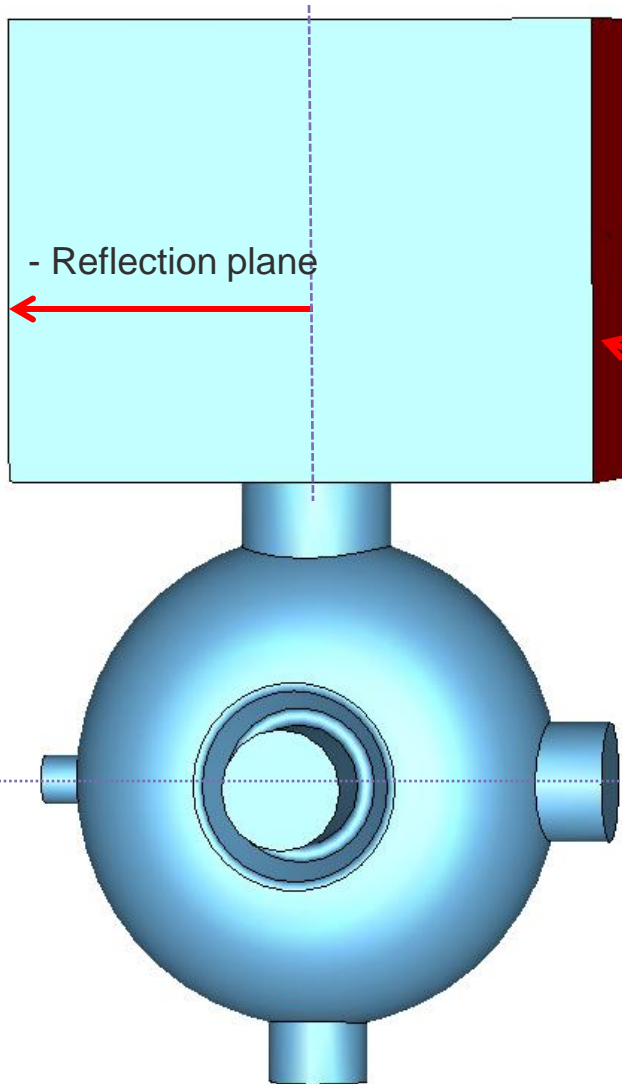
RF window port



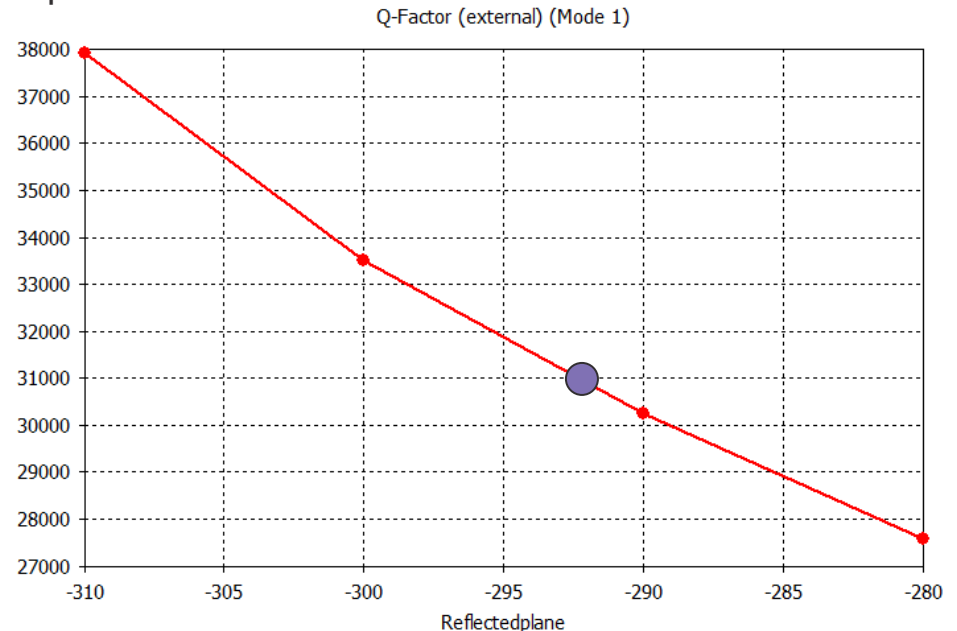
- Two normal conducting 500 MHz single-cell bunching cavities are on loan from Daresbury Lab.
- The cavities were formerly used in SRS, operating at 300 kV.
- Fundamental power coupler is of a waveguide type coupled to the cavity via an aperture (port) at the cavity top, sealed with a disk ceramic window.

Parameter	500 MHz buncher
V_{acc} [MV]	0.3
R/Q [Ohm]	178.5
Geometry factor [Ohm]	38.2
Q_0	31,000
Cavity wall RF power loss [kW]	16.3
RF coupling	1
Available RF power [kW]	50

RF coupling adjustment



- The RF power coupling is adjusted via moving a reflection plane.
- The original SRS configuration included a moveable waveguide short.
- As there will be no beam loading in CeC PoP, we will adjust the short position for unity coupling only once – no need for a moveable short.



Status and test plans for bunchers

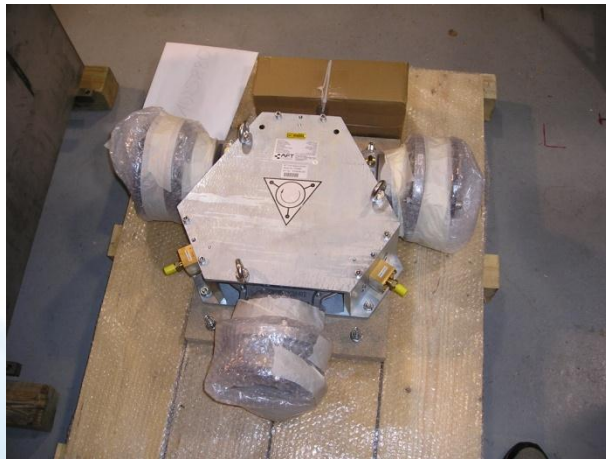
- The cavities were delivered to BNL in early 2012.
- They are currently undergoing particulate-free cleaning and refurbishing.
- Our near future plans include a vacuum bake, low-level RF measurements, adjusting RF power coupling, and testing the frequency tuner.
- Following that, the cavities will be installed in the RHIC tunnel, connected to the RF transmitter and RF conditioned to reach 300 kV.



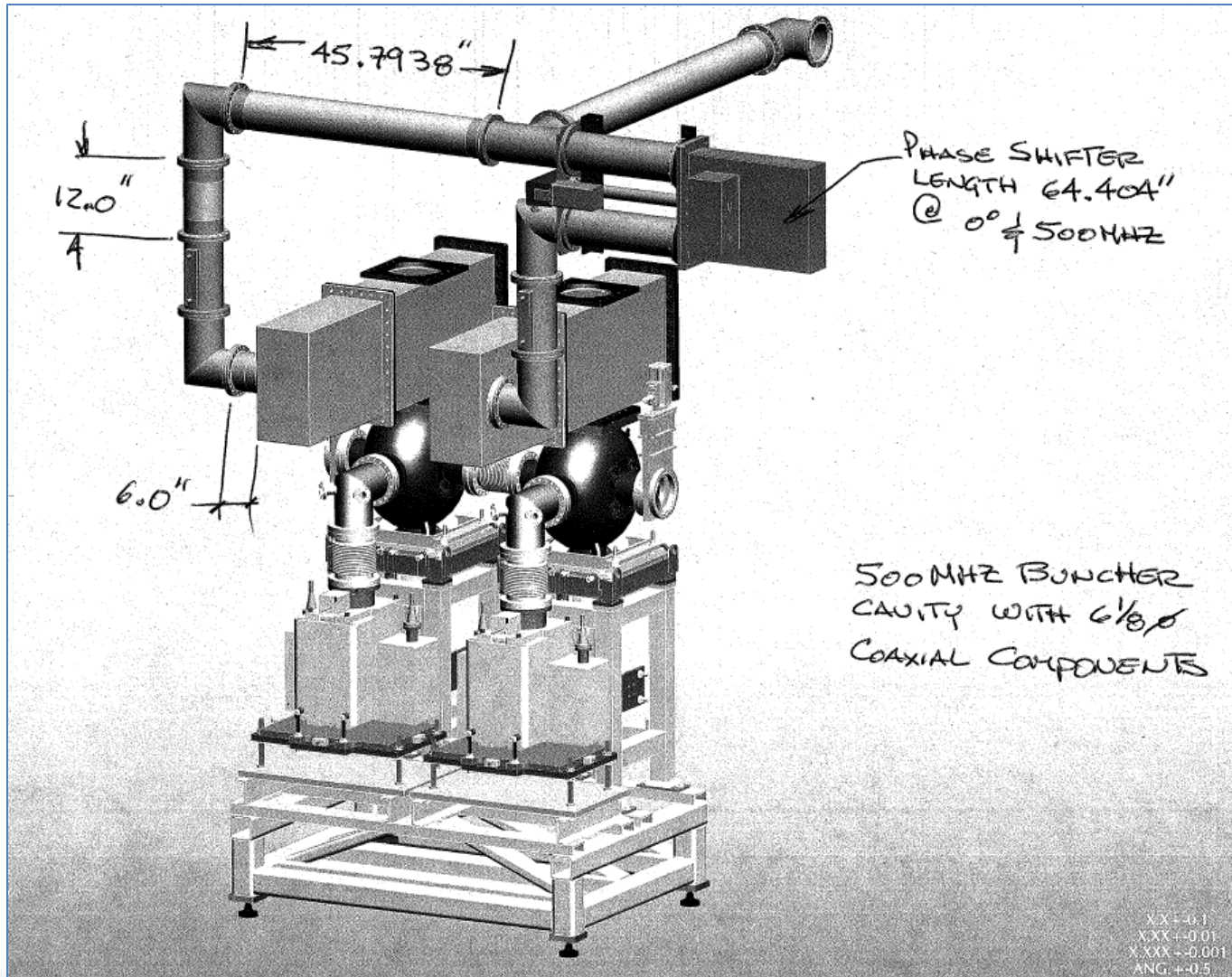
500 MHz 50 kW buncher system



500 MHz 50 kW buncher system



RF distribution system



112 MHz system



Class AB linear amplifier
2 kW CW minimum
65% efficient

Ferrite Microwave Technologies

Ferrite PN: UFC3-525MODA
Function: Isolator
Description: 3-port coaxial circulator
with port 3 terminated
Frequency: 112MHz +/- 2 MHz
Power: 2kW cw into a potential
full reflection
Insertion Loss: 0.2dB Maximum
Isolation: 20dB Minimum with a
matched load on port 3
Cooling: 3 GPM
Connector: 7/8" Coax



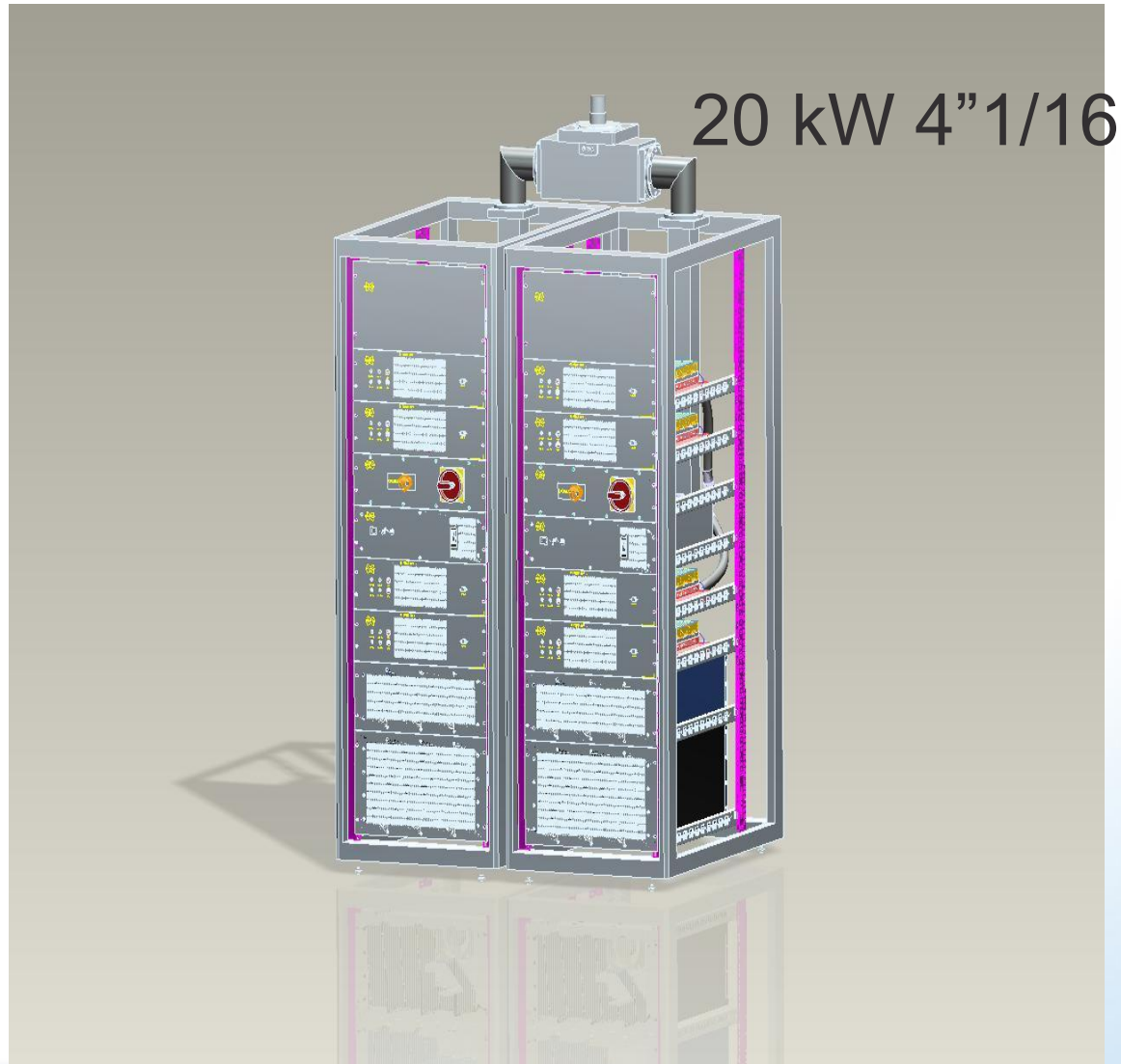
SRF gun



704 MHz RF amplifier



Bruker BioSpin



LLRF

- The LLRF system for CeC PoP is based on the LLRF Upgrade Platform already successfully deployed at RHIC, AGS, EBIS and the ERL Experiment.
- The Platform has been described extensively elsewhere. See for example:
 - <http://accelconf.web.cern.ch/accelconf/PAC2011/papers/weobn5.pdf>
 - <http://accelconf.web.cern.ch/accelconf/PAC2011/papers/mop283.pdf>
 - <https://indico.desy.de/conferenceOtherViews.py?view=nicecompact&confId=3391>
 - <http://accelconf.web.cern.ch/accelconf/PAC2011/papers/mop282.pdf>



- Platform based LLRF system for the ERL Experiment.
- System comprises three 703MHz sub-systems (Linac, Gun and Laser), integrated and locked via a common 100MHz Master Oscillator and the “Update Link”.
- CeC PoP is a **very** similar architecture.